

University of Dundee

Riddles of Form

Jarron, Matthew

Published in:
Art and Science in Word and Image

DOI:
[10.1163/9789004361119](https://doi.org/10.1163/9789004361119)

Publication date:
2019

Document Version
Peer reviewed version

[Link to publication in Discovery Research Portal](#)

Citation for published version (APA):
Jarron, M. (2019). Riddles of Form: D'Arcy Thompson in Word and Image. In K. Williams, S. Aymes, J. Baetens, & C. Murray (Eds.), *Art and Science in Word and Image: Exploration and Discovery* (pp. 13-26). (Word and Image Interactions; Vol. 9). Brill Academic Publishers. <https://doi.org/10.1163/9789004361119>

General rights

Copyright and moral rights for the publications made accessible in Discovery Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from Discovery Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain.
- You may freely distribute the URL identifying the publication in the public portal.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Riddles of Form: D'Arcy Thompson in Word and Image

Matthew Jarron

Abstract

D'Arcy Thompson's ground-breaking book *On Growth and Form* (1917) is discussed as the starting point for the theme of the 2014 triennial conference *Riddles of Form*. This essay describes the far-reaching influence that the book has had in fields such as biology, systems theory, geography, architecture and art. It discusses the origin of the book in the context of Thompson's work at University College, Dundee and the development of his museum of zoology. The article concludes by describing the current version of the museum at the University of Dundee as a focal point for interdisciplinary interests in Thompson's work.

Essay

...the physicist proclaims aloud that the physical phenomena which meet us by the way have their forms not less beautiful and scarce less varied than those which move us to admiration among living things. The waves of the sea, the little ripples on the shore, the sweeping curve of the sandy bay between the headlands, the outline of the hills, the shape of the clouds, all these are so many riddles of form, so many problems of morphology, and all of them the physicist can more or less

easily read and adequately solve ... but it is on another plane of thought from the physicist's that we contemplate their intrinsic harmony, and 'see that they are good'. (Thompson, 1917, p.7)

This passage from D'Arcy Thompson's *On Growth and Form* provided the starting point for the theme of the 2014 triennial conference, *Riddles of Form*. It reveals Thompson's exceptional ability to conjure up poetic imagery within the framework of a scientific textbook. Of the many artists who have been drawn to this extraordinary book, perhaps the photographer Susan Derges is the one whose work most closely connects to this memorable passage. **[PLACE ILLUSTRATION 1 HERE]**

Based in Devon, Derges is best known for creating images without a camera. She often works at night, using the light of the moon and a hand-held torch to expose images directly onto light sensitive paper. The resulting photographs capture natural patterns of exceptional beauty. *Arch 2* (see fig. 1) is from a series of four large prints focusing on the cycles of birth, growth, decay, death and renewal that occur throughout the year in a field close to her studio on Dartmoor. The prints show the sky reflected in a pool of water in different ways according to the time of year. To create the cloud images, patterns produced by ink drops in water (discussed in *On Growth and Form*) were scanned directly from a glass tank. These were printed onto large transparencies then placed beneath a glass tank containing water, bracken, grasses and reeds from the field. Direct prints were made onto Ilfochrome paper placed beneath both the tank and the transparency, which were then photographed to make large scale C-type prints. The work was acquired by the University of Dundee Museum Services in 2013 and displayed to delegates during the *Riddles of Form* conference. **[PLACE ILLUSTRATION 2 HERE]**

Thompson himself was chiefly concerned with riddles of form on an altogether smaller scale. Figure 2 shows one of the teaching aids he would have used as Professor of

Natural History at University College, Dundee. An exquisitely delicate hand-blown glass model of a jellyfish, it presents its own riddle of form in its seemingly impossible yet intricately detailed construction. In *On Growth and Form*, Thompson noted that “the art of the glass-blower is full of lessons for the naturalist as for the physicist; illustrating as it does the development of a host of mathematical configurations and organic confirmations which depend essentially on the establishment of a constant and uniform pressure within a closed elastic shell or fluid envelope (Thompson, 1917, p.238).”

Thompson was writing here about splash patterns, comparing the shape of ink drops in water with the form of marine invertebrates like jelly-fish because of the similar physical forces acting upon them, but his reference to the glass-blower suggests he may have been thinking about this very model—or even had it sitting on his desk in front of him—as he wrote. Here we might cite Jackson Pollock as another significant artist who read and was influenced by *On Growth and Form*—and what might he have made of this section on splash patterns?

In summer 2014 (the same time that the University of Dundee was hosting the *Riddles of Form* conference), this model (made by the German-based glassblowers Leopold and Rudolf Blaschka), was on loan to the Henry Moore Institute (HMI) in Leeds as part of an exhibition exploring the influence of Thompson on Moore and other sculptors, curated by the HMI’s Head of Sculpture Studies, Lisa Le Feuvre, following a period of in-depth engagement with the collections in the D’Arcy Thompson Zoology Museum. The model also featured as the main promotional image for an accompanying study day and publication (Le Feuvre, 2014).

The HMI project was one example of the on-going interest in D’Arcy Thompson’s work and the continuing influence of his ideas and collections which this essay aims to explore through word and image. An important centre for much of the activity described here is the D’Arcy Thompson Zoology Museum at the University of

Dundee, under the curatorship of the author of this essay. Like the organisms Thompson studied, the museum has undergone a number of transformations over the years.

[PLACE ILLUSTRATION 3 HERE]

Thompson arrived in January 1885 at the age of just 24 to take up the first Chair of Biology at what was then University College, Dundee. The Chair was renamed Natural History in 1888 when Thompson was joined by another great interdisciplinary and visual thinker, Patrick Geddes, for whom a part-time Chair of Botany was specially created. The two became friends and allies, but while Thompson looked at individual organisms, Geddes developed a wider outlook, comparing biological systems to sociological ones.

Thompson quickly realised that what he needed above all in order to teach his students was a museum containing representatives of all the principal groups of organisms. Over the next twenty years, he built up “a museum with such a wealth of material that [it was claimed] few universities in Great Britain could outrival it (Peacock, *obit*)”. He acquired specimens from biological supply houses, zoos and other museums, as well as numerous private collectors both locally and around the world. In particular, Thompson was able to use his connections with the Dundee whaling captains to secure rare Arctic specimens otherwise unobtainable.

After Thompson left Dundee to take up the Chair of Natural History at the University of St Andrews in 1917, the museum continued to be maintained by his successors, but in 1957 the building that housed it was demolished. Smaller displays were created in the 1980s and 90s, but it was only in 2007 that space was found to create a new version of the museum, which opened to the public in 2008 (see fig. 3). Since then it has been the showcase for a fascinating collection of natural history specimens, but also a space to explore the achievements, ideas and influence of Thompson himself.

From the point of view of word and image studies, Thompson’s work is particularly interesting. His masterpiece *On Growth and Form* was a truly radical text,

proposing for the first time that the way organisms grow and the shapes that they take were the result not of some unexplainable vitalist force as was hitherto believed but were directly caused by physical forces and the fundamental laws of mathematics.

The descriptive quality of Thompson's prose has already been noted, but it is worth pointing out the peculiarly aesthetic terms that he uses, which have made the book enormously appealing to artists: "For the harmony of the world is made manifest in Form and Number, and the heart and soul and all the poetry of Natural Philosophy are embodied in the concept of mathematical beauty" (Thompson, 1917, pp.778-9). The visualisation of this passage in Figure 4 was created by an Illustration student from Duncan of Jordanstone College of Art & Design as part of a class project in the museum. **[PLACE ILLUSTRATION 4 HERE]**

Thompson also makes repeated use of artistic analogies in *On Growth and Form*—as well as the work of the glass-blower he also refers to "the potter's art (1917. p.238)" and the "sculptor's clay (1917, p.631)". It was also the work of a graphic artist that inspired the most celebrated (and controversial) part of Thompson's book, his Theory of Transformations. **[PLACE ILLUSTRATION 5 HERE]**

Thompson had long believed that Darwin's theory of evolution by natural selection could not explain all of the changes of form witnessed in nature. Here, he proposed instead that physical forces could cause a transformation from one species into another based on mathematical principles. His starting point in demonstrating this was Albrecht Dürer's *Four Books on Human Proportion* (published 1512-28), in which, according to Thompson, "the manner in which the human figure, features, and facial expression are all transformed and modified by slight variations in the relative magnitude of the parts is admirably and copiously illustrated (1917, pp.740-1)." Thompson combined Dürer's techniques with those of René Descartes, using his method of co-ordinates to turn Dürer's proportional drawings into scientific diagrams. Thompson noted that the idea

behind Descartes' method of co-ordinates was "to find a way of translating the *form* of a curve (as well as the position of a point) into *numbers* and into *words* (1917, p.723, original emphases)." By applying a Cartesian grid to the form of an animal or a part of an animal, and subjecting it to increasingly complex mathematical transformations, he was able to demonstrate that laws of growth rather than evolution could be used to explain the different forms of related species (see fig. 5).

In any scientific textbook there is a unique relationship between the words and the accompanying diagrams or images. *On Growth and Form* is perhaps unique in the way that its words and images have worked together to inspire an extraordinary influence in fields far beyond those that Thompson himself could ever have imagined.

Thompson was certainly a passionate believer in interdisciplinarity. He believed in giving students as great a breadth of knowledge as possible, telling them:

if you dream, as some of you, I doubt not, have a right to dream, of future discoveries and inventions, let me tell you that the fertile field of discovery lies for the most part on those borderlands where one science meets another. There is a cry in the land for specialisation... but depend upon it, that the specialist who is not reinforced by a breadth of knowledge beyond his own specialty is apt very soon to find himself only the highly trained assistant to some other man... Try also to understand that though the sciences are defined from one another in books, there runs through them all what philosophers used to call the *commune vinculum*, a golden interweaving link, to their mutual support and interpretation. (Thompson, 1903, pp.8-9)

It would be precisely this interweaving link that Thompson would demonstrate so powerfully in *On Growth and Form*. He had begun his researches into mathematical

patterns in nature as early as 1889, but aware of how controversial the ideas were, he hesitated to publish them. It would be 1908 before he first published on the topic—a paper in *Nature* on “The Shape of Eggs and the Causes which determine them” (Thompson, 1908). In 1911 he raised the subject at the British Association meeting in Portsmouth, claiming that “the form of an object is a ‘diagram of Forces’,— in this sense, at least, that from it we can judge or deduce the forces that are acting or have acted upon it (Thompson, 1911, p.423).” This powerful concept, again linking word and image, has become one of his most enduring metaphors.

Finally in 1915 his various ideas were assembled into book form under the title *On Growth and Form*. In compiling it he drew extensively on the resources available to him in Dundee, including the specimens in his museum. Many of the examples referred to in the book are still represented in the collection today, including models of microscopic organisms such as radiolaria and foraminifera and the sectioned nautilus shell that remains the most iconic image of mathematical biology, its growth taking the form of a logarithmic spiral.

On Growth and Form was finally published in 1917 and attracted immediate attention from a wide range of sources. Although only 500 copies were printed, reviews quickly appeared in publications as diverse as *Country Life*, the *Times Literary Supplement*, *Veterinary Review* and *Engineering*. Although all were laudatory, it is notable that they generally focused on the quality of the writing rather than the scientific ideas behind it. It soon became apparent that the book’s immediate impact in the field of biology was to be minimal. As Thompson had feared, many took it as an attack on Darwinian theory (which was never the intention) and for a long time it seemed that developments in the study of genetics rendered its ideas irrelevant. Thompson’s successor in Dundee, Prof Alexander Peacock, claimed that “D’Arcy’s originality and versatility made him unclassifiable by formal standards and his individualism inhibited his founding of a

school for the development of his ideas (Peacock, 1960).” But the ideas lingered, and found new followers, who styled themselves developmental biologists rather than evolutionary ones. They included Julian Huxley and C H Waddington, but also figures from outwith biology, such as the father of modern computing, Alan Turing.

On Growth and Form shows how complex biological systems can be understood by fundamental mathematical principles, and as such Thompson’s ideas provided the basis for the development of modern systems theory. Turing’s experimental thinking machines rely on similar ideas, and in the early 1950s Turing turned his attention to biology with his landmark paper “The Chemical Basis of Morphogenesis” (Turing, 1952). This began an investigation into animal patterning that Thompson had raised the possibility of but had not himself attempted. Turing’s work was entirely about turning number into form, demonstrating how mathematical equations applied to different chemicals in the body that Turing called morphogens could create visual patterns such as this. In 1988 his ideas were taken further by James Murray in his celebrated paper “How the Leopard Gets its Spots”, which proposed that a single mathematical model called reaction-diffusion could possibly explain most if not all of the wide variety of animal coat markings found in nature (Murray, 1988). More recently, in 2012 researchers at King’s College London provided the first experimental evidence to confirm Turing’s ideas, identifying the actual morphogens involved (Economu *et al*, 2012).

By the 1980s the two previously opposing biological camps were being brought back together and the growth of evolutionary-developmental biology (popularly known as evo-devo) caused Thompson’s work to be looked at again by the evolutionists and geneticists who had hitherto dismissed it. Developments in mathematical modelling techniques have allowed the theories of *On Growth and Form* (like those of Turing) to be tested scientifically for the first time and new genetic discoveries have confirmed many of Thompson’s key ideas. In 2015, for example, an international research team led by the

University of Bath's Centre for Regenerative Medicine was able to test his propositions about the effects of gravitational forces on body shape, by discovering a gene that helps resist gravity. Their experiments on medaka fish show that disruption of the gene results in a flattened body shape exactly as Thompson had predicted (Porazinski *et al*, 2015).

Even arch-geneticists like Richard Dawkins now acknowledge the influence that Thompson's work has had on them (Dawkins, 1996, p.8). Prof Pedro Miramontes of the National Autonomous University of Mexico, one of the many institutions around the world now specialising in biomathematics, recently stated that Thompson "simply will be the most influential character in the future of biology (Miramontes, 2011, p.1)."

Thompson's impact does not stop there. His importance to systems theory was also recognised by Norbert Wiener, the pioneer of cybernetics, acknowledged in his landmark book *Cybernetics or Control and Communication in the Animal and the Machine* (1948). It also proved an inspiration to the anthropologist Claude Lévi-Strauss, who refers to Thompson in his important book on *Structural Anthropology* (1963). In geography the book has also proved a significant influence, one example being the Worldmapper series of cartograms, distorted maps taking the iconic transformation diagrams as their starting point (Gaster and Newman, 2004).

In architecture and engineering, *On Growth and Form* has inspired creators and practitioners from Le Corbusier and Mies van der Rohe to Norman Foster and Cecil Balmond. The diagrams comparing bridges to animal and dinosaur skeletons made many designers think about structures in a new way, and Thompson's work on the mechanical efficiency of soap bubbles and the structural tension of dragonfly wings directly inspired the development of lightweight structures such as Buckminster Fuller's geodesic domes and Frei Otto's Olympic stadium in Munich. In particular, the idea of organisms as diagrams of forces, constantly subject to transformation through external pressures, lies at the root of the theories of emergence, organic architecture and natural design that

form a fundamental part of current architectural theory (Beesley and Bonnemaïson, 2008).

Perhaps most significant, particularly in a word and image context, is the widespread influence that Thompson's work has had in the world of art. The sculptor Henry Moore was perhaps the first to discover the potential of *On Growth and Form*, reading it as an art student in Leeds, then later discussing it with the influential art critic Herbert Read. Read then shared his own copy with other artists, in particular a circle of modernist sculptors and painters based in St Ives in the 1930s including Barbara Hepworth and Naum Gabo. For these pioneers of abstract art in Britain, Thompson's work shared their concern with revealing hidden structures of life.

In the 1940s the second edition of the book was enthusiastically taken up by a group of students at the Slade School of Fine Art in London, including Nigel Henderson, Richard Hamilton, Eduardo Paolozzi and the Dundee-born William Turnbull. In 1951, Hamilton staged an influential exhibition called *Growth and Form* at the Institute of Contemporary Arts, which was opened by Le Corbusier.

Along with another D'Arcy Thompson enthusiast, Victor Pasmore, Hamilton would go on to become an important teacher at the Department of Fine Art in King's College, Newcastle. The new Basic Design Course they introduced proved to be hugely influential on art schools around the country, and it included *On Growth and Form*-based exercises. Thompson's work thus continued to inspire generations of artists long after his death.

Nor was the influence restricted to Britain—Laszlo Moholy-Nagy and Salvador Dali both read *On Growth and Form* and wrote about it in their visionary publications *Vision in Motion* (1947) and *50 Secrets of Magic Craftsmanship* (1948), both exceptional combinations of word and image.

It is apparent, therefore, that this one book, written in Dundee using the specimens in the Zoology Museum, has had an extraordinary global impact that is still just beginning to be fully understood. The challenge for the museum's curatorial staff is how best to relate all this to the specimens on display—how can they act as signifiers for this complex story while at the same time fulfilling their primary function as objects in a natural history museum?

In 2010 the 150th anniversary of Thompson's birth provided a starting point for developing the interdisciplinary potential of the museum. With a grant from the Royal Society, a series of activities was staged including public lectures by Nobel-prizewinning biologist Lewis Wolpert and renowned art historian Martin Kemp; a discussion between philosopher Mary Midgley and Turner Prize-nominated artist Paul Noble; and the publication of a new history of the museum (Jarron and Caudwell, 2010).

The museum has also been developed as a resource for teaching and research outwith the Life Sciences. Students from undergraduate and postgraduate programmes in Education, Art & Design and Creative Writing undertake regular projects based around Thompson's ideas and collections. Artwork by some of these students has since entered the collection and is shown in the museum alongside some of the poems written by Creative Writing students.

In 2012-13, the museum was the recipient of an Art Fund RENEW scheme grant allowing the acquisition of a significant collection of art inspired by Thompson—including pieces by Henry Moore, Victor Pasmore, Wilhelmina Barns-Graham and contemporary artists such as Will Maclean and Peter Randall-Page (Jarron, 2014). The project also allowed the museum to commence an artist-in-residence programme with Lindsay Sekulowicz in 2012, followed by Gemma Anderson in 2013 and Ellen K. Levy in 2014. **[PLACE ILLUSTRATION 6 HERE]**

Anderson's work is of particular interest in a word and image context in that (as she explained in her fascinating paper at the *Riddles of Form* conference) she has devised a new visually based approach to the understanding of natural science, as part of her PhD research into what she terms "Isomorphology", the study of shared patterns across different natural forms and the role of the artist in helping scientists to understand these (see fig. 6). She explains: "As a holistic and visual approach to classification, Isomorphology runs parallel to scientific practice while belonging to the domain of artistic creation. It is complementary to science: addressing relationships that are left out of the scientific classification of animal, vegetable and mineral morphologies (Anderson, 2013, p.4)." Thompson's work is therefore central to her practice, and indeed her recent solo exhibition in Berlin was titled *Riddles of Form*.

All of this activity has helped us to position the Museum as an adaptable and experimental space that acts like a locus point on one of Thompson's transformation diagrams. Its specimens may appear fixed and unchanging but they can become the starting points for any number of different journeys. The *Riddles of Form* conference is just one such journey.

Sources Cited

Anderson, Gemma. *An Introduction to Isomorphology*. London: Super/collider, 2013.

Beesley, Philip and Bonnemaïson, Sarah, eds. *On Growth and Form: Organic Architecture and Beyond*. Halifax: Tuns Press, 2008.

Economu, A D, Ohazama, A, Sharpe, P T, Basson, M A, Cobourne, M T, Greene, J B A. "Periodic stripe formation by a Turing mechanism operating at growth zones in the mammalian palate." *Nature Genetics* 44:3 (2012): 348-351.

Dali, Salvador. *50 Secrets of Magic Craftsmanship*. New York: Dial Press, 1948.

Dawkins, Richard. *Climbing Mount Improbable*. New York: W.W. Norton & Co., 1996.

Gastner, M T and Newman, M E J. "Diffusion-based method for producing density equalizing maps." *Proceedings of the National Academy of Sciences USA* 101 (2004): 7499-7504.

Jarron, Matthew & Caudwell, Cathy. *D'Arcy Thompson and his Zoology Museum in Dundee*. Dundee: U of Dundee Museum Services, 2010.

Jarron, Matthew. "Editorial." *Interdisciplinary Sciences Reviews* 38:1 (2013): 1-11.

Jarron, Matthew. *A Glimpse of a Great Vision: The D'Arcy Thompson Zoology Museum Art Fund Collection*. Dundee: U of Dundee Museum Services, 2014.

Le Feuvre, Lisa, ed. *Essays on Sculpture 70: D'Arcy Thompson's On Growth and Form*. Leeds: Henry Moore Foundation, 2014.

Lévi-Strauss, Claude. *Structural Anthropology*. New York: Basic Books, 1963.

Miramontes, Pedro, Letter to the author, 2011.

Moholy-Nagy. *Vision in Motion*. Chicago: Paul Theobald, 1947.

Murray, James. "How the Leopard Gets its Spots." *Scientific American* 256:3 (1988): 80-87.

Peacock, Alexander. MS of obituary for D'Arcy Thompson. U of Dundee Archive Services, Recs C/2/12/3(2).

Peacock, Alexander. MS of BBC lecture broadcast 1 May 1960. U of Dundee Archive Services, URSF 2/12/3(14).

Porazinski, Sean, Wang, Huijia, Asaoka, Yoichi, Behrndt, Martin, Miyamoto, Tatsuo, Morita, Hitoshi, Hata, Shoji, Sasaki, Takashi, Krens, S F G, Osada, Yumi, Asaka, Satoshi, Momoi, Akihiro, Linton, Sarah, Miesfeld, J B, Link, B A, Senga, Takeshi, Castillo-Morales, Atahualpa, Urrutia, A O, Shimizu, Nobuyoshi, Nagase, Hideaki, Matsuura,

Shinya, Bagby, Stefan, Kondoh, Hisato, Nishina, Hiroshi, Heisenberg, Carl-Philipp and Furutani-Seiki, Makoto. “YAP is essential for tissue tension to ensure vertebrate 3D body shape”. *Nature* 14215 (2015) published online at doi:10.1038/nature14215.

Thompson, D’Arcy. “Address delivered at the opening of session 1903-4.” *The College* (December 1903): 8-9.

Thompson, D’Arcy. “The Shape of Eggs and the Causes which determine them.” *Nature*, 78 (1908): 111-113.

Thompson, D’Arcy. “Magnalia Naturae; or The Greater Problems of Biology.” *Science* 34:875 (1911): 417-428.

Thompson, D’Arcy. *On Growth and Form*. Cambridge: Cambridge UP, 1917.

Turing, Alan. “The Chemical Basis of Morphogenesis.” *Philosophical Transactions of the Royal Society B*: 237 (1952): 37-72.

Wiener, Norbert. *Cybernetics or Control and Communication in the Animal and the Machine*. New York: John Wiley & Sons, 1948.

Illustration captions

Fig 1. Susan Derges (1955-), *Arch* 2, 2007-8. Digital C-print on paper, 211x142cm.

Dundee: University of Dundee Museum Services, presented by the Art Fund and the Esmée Fairbairn Foundation. Copyright the artist / Purdy Hicks Gallery.

Fig 2. Blaschka & Son, Glass model of a jellyfish from D’Arcy Thompson’s collection, ca.1889. Dundee: University of Dundee Museum Services. Photograph by Stephen Robinson.

Fig 3. The D'Arcy Thompson Zoology Museum, 2008. Dundee: University of Dundee Museum Services. Photograph by Stephen Robinson.

Fig 4. Gavin Rutherford, *Untitled*, 2010. Set of four digital prints. Dundee: University of Dundee Museum Services.

Fig 5. Transformation diagram from the first edition of D'Arcy Thompson's *On Growth and Form* showing the mathematical relationship between the fish *Diodon* and *Orthogoriscus*. Originally published by Cambridge University Press, 1917.

Fig 6. Gemma Anderson (1984-). *The primary forms and symmetries of Isomorphology*. Classification system reproduced from *An Introduction to Isomorphology*, published by super/collider, 2013.

Author's Biography

Matthew Jarron is Curator of Museum Services at the University of Dundee, which includes the curatorship of the D'Arcy Thompson Zoology Museum. He is the author of several publications relating to the museum collections including *D'Arcy Thompson and his Zoology Museum in Dundee* (2010, co-authored with Cathy Caudwell) and has edited or co-edited issues of the *Journal of the Scottish Society for Art History, Museum Management & Curatorship* and *Interdisciplinary Science Reviews*. He was a member of the organising committee for the *Riddles of Form* conference.

List of terms/names for index:

Anderson, Gemma

Balmond, Cecil

Blaschka, Leopold and Rudolf

British Association for the Advancement of Science

Dali, Salvador

Darwin, Charles

Dawkins, Richard

Derges, Susan

Descartes, Rene

Duncan of Jordanstone College of Art & Design

Dürer, Albrecht

Foster, Norman

Fuller, Buckminster

Gabo, Naum

Geddes, Patrick

Hamilton, Richard

Henderson, Nigel

Henry Moore Institute

Hepworth, Barbara

Huxley, Julian

Institute of Contemporary Arts

Isomorphology

Kemp, Martin

Kings College, London

Kings College, Newcastle

Le Corbusier

Le Feuvre, Lisa

Levi-Strauss, Claude

Levy, Ellen K.

Maclean, Will

Midgley, Mary

Miramontes, Pedro

Moholy-Nagy, Laszlo

Moore, Henry

Murray, James

Noble, Paul

Otto, Frei

Paolozzi, Eduardo

Pasmore, Victor

Peacock, Alexander

Pollock, Jackson

Randall-Page, Peter

Read, Herbert

Sekulowicz, Lindsay

Slade School of Fine Art

Thompson, D'Arcy

Turing, Alan

Turnbull, William

University College, Dundee (see University of Dundee)

University of Bath

University of Dundee

University of St Andrews

van der Rohe, Mies

Waddington, Conrad Hal

Wiener, Norbert

Wolpert, Lewis

Worldmapper